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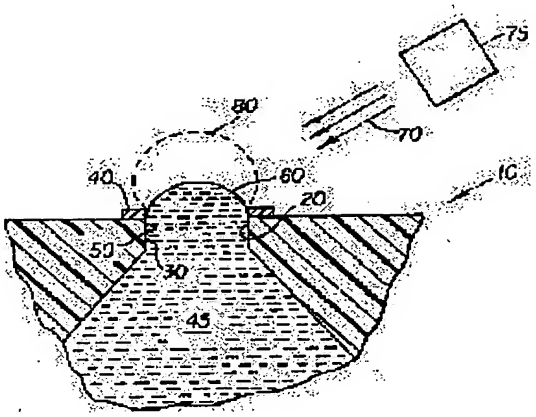
(54) PRINTER AND PRINTING METHOD USING PHOTO-ACTIVE INK DISCHARGE SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an ink discharge mechanism that generates extended ink drops when light-sensitive ink is radiated with an optical beam and is used in a DOD ink jet printer.
SOLUTION: There is disclosed an ink jet printer and a method of printing utilizing an photo-active ink discharge system. The printer is equipped with at least one nozzle having an ink material including light-sensitive ink. The ink forms a non-extended liquid drop meniscus. As a light beam is introduced to the non-extended liquid drop meniscus, a surface tension of the light-sensitive ink is lowered and then the extended liquid drop meniscus is created. By forming the extended liquid drop meniscus, the ink is transferred to a receiver, i.e., a medium.



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CLAIMS

[Claim(s)]

[Claim 1] It is at least one nozzle possessing the path which has the ink object which consists of photosensitive ink. Said at least one nozzle to which said at least one nozzle path reaches said nozzle delivery so that the non-elongated drop meniscus attached to said ink object may be located in a nozzle delivery, The printer to which the receiver which the light source which leads a light beam to said non-elongated drop meniscus is provided, and the elongated drop meniscus arises as the expanding section of said non-elongated drop meniscus arises, and is located to said elongated drop meniscus is made to move ink.

[Claim 2] The printing approach including the process which forms a non-elongated photosensitivity liquid ink drop meniscus in the delivery of two or more nozzles, the process which applies a light beam to some non-elongated liquid ink drop meniscuses [at least] so that the elongated ink drop meniscus may be formed, and the process to which a receiver is made to move said elongated liquid ink drop meniscus to ink.

[Claim 3] It is the printer which said liquid-ink drop meniscus elongates toward outside when said at least one nozzle path possesses said at least one nozzle which reaches a nozzle delivery so that the liquid-ink drop meniscus which is at least one nozzle possessing the path which has the ink object which consists of photosensitive ink which has the surface tension which declines when it exposes, and is attached to said ink object may be located in a nozzle delivery, and it exposes.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the printer and the printing approach of an on-demand (henceforth "DOD") ink jet printer gestalt of using an optical activity ink emission system.

[0002]

[Description of the Prior Art] As for an ink jet printer, in the field of a printing technique, it is well-known to make ink breathe out toward paper from an ink jet head, and to print the information on desired on the paper. With the structure of the conventional ink jet printer, the regurgitation of a liquid ink drop is performed by various ink jet heads like the magnet using the electronic limit element of an inorganic material on demand type, or a head on demand type. Furthermore, with the structure of the conventional ink jet printer, the light beam was used as a measurement means for measuring the property of ink.

[0003] The structure of an ink jet head is indicated and LED emits light to a photodiode, and it is used for U.S. Pat. No. 5,841,448 in order that the measurement as a result of luminescence of light may subsequently detect the amount of ink, ink concentration, etc.

[0004] Making the specific ink component which reacts chemically react chemically using an electromagnetic wave, and generating gas within a chamber is reported to U.S. Pat. No. 4,607,267. A liquid ink drop is made to breathe out with the pressure produced as a result of the generation of gas.

[0005] Use of the light source as a means for measuring and/or supervising the surface tension of a liquid is indicated by U.S. Pat. No. 4,611,486.

[0006] The printing concept by applying a light beam to a non-elongated drop so that not only special use of photosensitive ink but the non-elongated liquid ink drop which produces a liquid ink drop may be expanded is not indicated by the structure of the

advanced technology including the above mentioned patent, and suggestion is not carried out to it, either.

[0007]

[Problem(s) to be Solved by the Invention] This invention aims at offering the ink emission device which the liquid ink drop elongated when a light beam was irradiated by photosensitive ink produces and which is used for a DOD ink jet printer.

[0008]

[Means for Solving the Problem] The above-mentioned purpose is at least one nozzle possessing the path which has the ink object which consists of photosensitive ink. Said at least one nozzle to which said at least one nozzle path reaches said nozzle delivery so that the non-elongated drop meniscus attached to said ink object may be located in a nozzle delivery, As the expanding section of said non-elongated drop meniscus arises, the light source which leads a light beam to said non-elongated drop meniscus is provided, and the elongated drop meniscus arises, and it is attained by the printer to which the receiver located to said elongated drop meniscus is made to move ink.

[0009] By the equipment and the approach of this invention, it is possible to apply a light beam to the nozzle array which has a non-elongated liquid ink drop alternatively, a non-elongated selection liquid ink drop develops, and ink migration to a receiver or a medium is enabled.

[0010] This invention relates to the printer possessing at least one nozzle. The at least one nozzle possesses the path which has the ink object which consists of photosensitive ink. The at least one nozzle path reaches a nozzle delivery so that the non-elongated drop meniscus attached to the ink object may be located in a nozzle delivery. Furthermore, the light source currently converted so that a light beam may be led to a non-elongated drop meniscus is provided, the drop meniscus which was made to elongate a non-elongated drop meniscus and was elongated arises, and a printer moves to the receiver located to the drop meniscus which ink therefore elongated.

[0011] Moreover, this invention offers the printing approach including the process which forms the non-elongated photosensitivity drop meniscus of two or more nozzle deliveries, the process which applies a light beam to a part of non-elongated liquid ink drop [at least] so that the elongated drop meniscus may be produced, and the process to which the ink from the **** meniscus elongated to the receiver is moved.

[0012] Furthermore, this invention offers the printer possessing at least one nozzle. The at least one nozzle possesses the path which has an ink object. The at least one nozzle path reaches a nozzle delivery so that the liquid ink drop meniscus attached to the ink object may be located in a nozzle delivery. When the ink object is exposed, it consists of

photosensitive ink in which surface tension declines, and when it exposes, a liquid ink drop meniscus elongates it toward outside.

[0013] Furthermore, the process which prepares at least one nozzle of the printer which has the ink maintenance field where this invention reaches a nozzle delivery, So that an ink object may be formed in the above-mentioned ink maintenance field and the non-elongated drop meniscus attached to the ink object may be located in a nozzle delivery The process which equips an ink maintenance field with photosensitive ink, and the process which prepares the light source in the location to the above-mentioned non-elongated drop meniscus so that a light beam may be led to a non-elongated drop meniscus are included. Consequently, it is related also with the assembly approach of a printer which forms the drop meniscus which the expanding section of a non-elongated drop meniscus produced and elongated.

[0014]

[Embodiment of the Invention] With reference to the drawing, the whole drawing is covered and the same reference number expresses the part which is the same or corresponds. Drawing 1 shows the print head 10 which has the array of the ink regurgitation nozzle 20. However, only one ink regurgitation nozzle is shown in drawing 1 . A print head 10 is a part of ink jet printer, and the equipment makes a liquid ink drop breathe out toward a receiver from an ink jet head, and it prints the information on desired to the receiver. Each nozzle 20 possesses the path 30 formed in the print head 10. As an option, the annular resistance heater 40 is arranged near the nozzle delivery, and electric power is supplied alternatively in the nozzle delivery 50. The ink object 45 is located in the ink maintenance field of a path 30, and the photosensitive ink by this invention contains it in the field. the predetermined pressure to which the non-elongated drop meniscus 60 is attached to the ink object 45, and the meniscus acts on the ink object 45 -- the nozzle delivery 50 -- outside -- going -- balance -- **** -- ******. There is the coloring matter or the pigment in sodium-dodecyl-sulfate SDS and 4, and 4'-screw (trimethylammonium HEKISHIROKISHI) azobenzene bromide and the mixed surfactant system containing BTHA in the example of available photosensitive ink.

[0015] Furthermore, as shown in drawing 1 , the light source 75 leads a light beam 70 to the non-elongated drop meniscus 60. Photosensitive ink is made to elongate the non-elongated drop meniscus 60 toward outside by applying a light beam 70 to the non-elongated drop meniscus 60 by use from the nozzle delivery 50. In the suitable example of this invention, a light beam 70 has predetermined wavelength, the ink is chosen so that it may be photosensitivity, and therefore, surface tension or a pressure declines quickly in the case of exposure. In the example of this invention in which a

nozzle array with a non-elongated meniscus exists, the light source 75 is positioned alternatively and is correctly led to one as which the non-elongated meniscus 60 chose the light beam 70. If the non-elongated meniscus 60 which the light beam 70 chose is hit, it will elongate toward outside and the elongated meniscus 80 will produce the meniscus 60 from the nozzle delivery 50.

[0016] As shown in drawing 2 , shortly after the elongated meniscus 80 arises, a print head 10 rotates (for example, 90 degrees). At this point, it moves in the direction of an arrow head 95, and a receiver or a medium 90 contacts the elongated meniscus 80, will be in the condition of distance X1 from a nozzle 20, and will move one or more liquid ink drops to a receiver 90.

[0017] In the first example of this invention, it prepares in the multiple cull cel 85 which rotates the array of a nozzle 20 around the spindle 97 shown in drawing 3 . The cull cel 85 has the non-elongated meniscus 60 in the second [at least] page of the example shown in drawing 3 , and the non-elongated meniscus 60 exists in the 4th page by all of the cull cels 85. When printing is desired, the cull cel 85 rotates and the non-elongated meniscus 60 with desirable drawing a light beam 70 meets the light source 75. The light source 75 is applied to the non-elongated meniscus 60 of a request of a light beam 70, a meniscus 60 develops and the elongated meniscus 80 produces it. Just behind that, it rotates, as shown in an arrow head, and the cull cel 85 meets a receiver 90. Therefore, when the meniscus 80 which the receiver 90 elongated by moving a receiver 90 in the direction of 95 is contacted, the elongated meniscus 80 makes a receiver 90 move ink. As another example, it can also understand the cull cel 85 that it is made to perform the both sides of rotation and migration in the direction of a straight line toward a receiver 90 rather than it moves a receiver 90 in the direction of 95.

[0018] Drawing 4 shows the graph explaining the property of the surface tension of the photosensitive ink of this invention. The graph of drawing 4 compares conventional ink, i.e., the ink of the advanced technology which is not photosensitivity, and the photosensitive ink of this invention, and expresses the value of the surface tension to time amount. As shown in drawing 4 , as compared with nonphotosensitivity ink, the rapid fall of surface tension occurs by using photosensitive ink. As shown in the dotted line of drawing 4 , specifically, the surface tension of the ink which is not photosensitivity is usually still fixed. As for the curve B as which the curve A which displays the photosensitive ink before exposure, and which is shown in drawing 4 , on the other hand, displays the photosensitive ink after exposure although the surface tension declines at the first rate, the surface tension declines quickly at the second rate quicker than the first rate. This offers the efficient method of generating the elongated

meniscus 80, as shown in drawing 1 , drawing 2 , and drawing 3 .

[0019] Drawing 4 shows that a non-choosing liquid ink drop can attain the lower surface tension of a selection (exposure) liquid ink drop also after time amount progress. Therefore, by including in the usual printing, ink is taken out from all nozzles, or it draws in, and ink is supplied immediately, and a unit 500 is offered so that a meniscus fresh to each nozzle may be made to form. Since it falls to automatically low level and a non-choosing drop is made to project, if the surface tension of an old meniscus performs the above-mentioned actuation and the surface tension of a meniscus is put in another way uniformly, it will reset surface age. Therefore, by performing the procedure which makes a meniscus refresh, as for the surface age of the meniscus under selection, it is desirable to make it refresh in 100 or less microseconds, and it is desirable that it is the same surface age substantially. Resetting the surface age of a meniscus is preventing a non-choosing drop's developing and moving to a receiver 90, when a receiver 90 contacts a print head. A unit 500 is which equipment which can attract or take out ink from a syringe, a pump, or a nozzle. Although it indicates that drawing 3 is open for free passage with the conduit 501 with which the unit 500 leads to one nozzles of all of a cull cel, this invention is not limited to this. The unit 500 is open for free passage to the single conduit, as it is open for free passage with two or more conduits which result in each nozzle or being illustrated. Moreover, the single conduit possesses the bulb and controls the nozzle which takes out or attracts ink. Furthermore, two or more units 500 can use with each unit which is only for [of specification] nozzles.

[0020] In the second example of this invention, as drawing 1 and drawing 5 show, it elongates further by use of the resistance heater 40, and as shown in drawing 5 , a meniscus 98 produces the elongated meniscus 80. By using a heater 40, the difference to which it increased between selection drops becomes realizable. That is, the distance X1 which make elongate further the meniscus 80 elongated by impression of the heat from a heater 40 toward outside, and it becomes unnecessary to bring a receiver 90 close to a nozzle 30, and to make station him that is, and is shown in drawing 2 is less than [of drawing 4 / distance X2], and it becomes possible to obtain in the form where exact liquid ink drop arrangement is reliable. The effectiveness of this example is that the need of maintaining an extremely short distance between a receiver 90 and a nozzle 20 minimizes. Another effectiveness of this example is to ease the need of maintaining the severe tolerance to a receiver's thickness. The difference in the height between a selection liquid ink drop and a non-choosing drop is 10 micrometers or less, and since a receiver's thickness is forced and it is made to change to below the amount, the severe tolerance in a receiver's 90 thickness is required.

[0021] The third example of this invention is explained with reference to drawing 1 and drawing 6 . As shown in drawing 6 , it elongates further, and the elongated meniscus 80 forms a meniscus 86, and emits a drop 150 by use of the resistance heater 40. That is, the meniscus 80 elongated by impression of the heat from a heater 40 develops toward outside further, finally is emitted, and flies toward a receiver 90. The effectiveness of this example is to eliminate the difficulty which arranges the receiver 90 near the nozzle 20 correctly. The amount of heat energy required for making the elongated meniscus 80 emit and making it fly toward a receiver 90 is larger than the case where electric power is made to supply to making the meniscus 80 which the heater 40 elongated form.

[0022] The fourth example of this invention is explained with reference to drawing 7 and drawing 8 . The cull cel 85 possesses first print head 10A, and the head shows the inside of a printing preceding paragraph story, in case the meniscus 80 which the drop was alternatively irradiated and elongated arises, and it counters the receiver 90 in a printing phase, and it shows second print head 10B so that it may illustrate. The cull cel 85 possesses the further print head, and expresses two print heads as for the purpose of explanation. In this example, the meniscus 80 which elongated the light beam 70 according to an exposure and the second force (** which does not use a heater 40) is emitted, or it flies toward a receiver 90. That is, as described above, surface tension is reduced by irradiating a light beam at the non-elongated meniscus 60. However, the surface tension does not fall to the level on which the elongated meniscus flies from a nozzle. for example, the thing for which a pressure pulse is impressed to a selection drop using a well-known converter like a piezoelectric transducer -- or electromagnetism -- the lowered surface tension exerted on the irradiated drop is conquered, and a drop 80 is made to fly to a receiver 90 alternatively according to structure of operation or bimorph structure

[0023] ****** of light and a pressure pulse is shown in drawing 7 , and the corner of the rectangle cull cel 85 explained to the above with reference to drawing 3 is shown. The ink meniscus of print head 10B which the ink meniscus of print head 10A is just going to irradiate by the light source 75 alternatively, and was on the other hand already irradiated alternatively is just going to make it breathe out the liquid ink drop 150 according to an operation of a piezoelectric transducer 115. When the static position of a piezoelectric transducer 115 is expressed as 116a and the electrical signal of the suitable timing from a controller (not shown) is received, a converter 115 curves to location 116b, presses sufficient ** for ink, and makes the low surface tension of an exposure (selection) drop conquer. In this situation, a receiver 90 does not contact the meniscus

elongated as described above, but the liquid ink drop 150 flies to a receiver 90. Again with reference to drawing 7 , print head 10A contains different ink from print head 10B. Therefore, the ink path 140 which supplies ink to print head 10A takes out ink from an ink container which is different in the ink path 130 which supplies ink to print head 10B.

[0024] In the fifth example of this invention, according to the second force given by the pressure pulse explained by use and drawing 7 of a light beam 70, the elongated meniscus 80 is expanded further and a receiver 90 is contacted rather than it makes it fly as shown in drawing 7 . The drop 80 which controlled the pressure pulse and was elongated is made to project further, and a receiver 90 is made to do contact migration alternatively, as shown in drawing 8 . Furthermore, a heater 40 operates to arbitration, and ****** with a pressure pulse, a meniscus 80 is made to project, and a receiver 90 is made to do contact migration alternatively.

[0025] The concept which gives the second force to an exposure drop is made to continue, the elongated drop meniscus 80 is made to emit alternatively, and a receiver 90 is made to fly in the sixth example of this invention by electric-field impression shown in drawing 9 . That is, as described above, surface tension declines by the exposure of the non-elongated meniscus 60 of a light beam. However, the surface tension does not decline to the level on which the elongated meniscus 80 flies from a nozzle. For example, the low surface tension of a drop 80 is conquered and a drop 80 is made to fly alternatively toward a receiver 90 by impressing electric field through the electric charge platen 100 and a connector 110. Furthermore, and/or a drop 80 performs a heater 40 (drawing 1) to arbitration, it can be made to be able to fly alternatively toward a receiver 90, and it can also make electric field impress using the pressure transducer (drawing 7).

[0026] In the seventh example of this invention, the elongated meniscus 80 is further expanded using the second force given by electric field as shown in drawing 10 , and a receiver 90 is contacted rather than it makes it fly as shown in drawing 9 . The exposure drop (elongated meniscus) 80 is made to project further, and the electric field generated by the platen 100 and the connector 110 make a receiver 90 it do contact migration alternatively. Furthermore, it performs to arbitration so that a heater 40 (drawing 1) and the pressure transducer (drawing 7) may be made to ****** with electric field, and a meniscus 80 is made to project further and a receiver 90 is made it to do contact migration alternatively.

[0027] In the eighth example of this invention, the luminescent diode 240 with desirable it being annulus voice is arranged around a nozzle 20, as shown in drawing 11 and

drawing 12 . The luminescent diode 240 leads a light beam 77 to the throat 65 of a nozzle 20, reduces surface tension, expands a drop 80 (elongated meniscus), is made to emit finally, and flies toward a receiver 90. This is performed by arbitration, irradiating a selection drop further using the light source 75. In this example, the selection drop 80 expands, as shown in drawing 1212 , it forms a drop 85, and subsequently the drop 150 which carries out emission flight toward a receiver 90 produces it only using light. Furthermore, it can be made to be able to ****** with the light from the luminescent diode 240 using a pressure pulse (drawing 7) and electric field (drawing 9 R> 9), or a heater 4 (drawing 1), and emission of the selection drop 80 can also be promoted. Drawing 13 and drawing 14 show the typical structure using the combination of the luminescent diode 240 near the nozzle delivery 50, and a heater 40.

[0028] The ninth example of this invention is explained with reference to drawing 15 . In this example, by use of a pressure pulse (drawing 7), heat (drawing 1), and/or electric field (drawing 9), the elongated drop meniscus 80 which is rather irradiated further with the beam of light 77 from the luminescent diode 240 rather than it makes it fly as shown by drawing 11 and drawing 13 projects further, and carries out contact migration at a receiver 90.

[0029] In order to make photosensitive ink irradiate about the light source 75, many another devices are used. For example, the light beam from the single light source irradiates photosensitive ink by the optical system possessing the scan element made to move light to the nozzle of another side from one nozzle. In this system, the various optical scan elements containing a scan mirror, scan prism, and a rotation mirror polygon are used. Furthermore, the system is manufactured by the compact by adopting scanning the mirror which is manufactured to silicon and by which micro processing was carried out. Or the light from a separately controllable light source array like a luminescent diode array or semiconductor laser is directly exposed to an ink jet nozzle array by the optical image system. It is possible to choose the ink nozzle which wants to irradiate the light source in an array by turning on a switch alternatively, and the nozzle to which a liquid ink drop is therefore made to emit can be chosen. The space optical modulator which has a controllable pixel according to many individuals located between the light source and an ink nozzle array is used for the third device. A space optical modulator is in any of a transparency mold like a transparency form LCD array, or a reflective mold like a micro mirror array. The light reflected or penetrated by the space optical modulator is used for irradiating a nozzle array alternatively.

[0030] Therefore, this invention provides a receiver with the ink jet printer using the ink emission system containing the photosensitive ink for alternative grant. To the

image of each color, 4 color color picture can print the effectiveness of this invention with one pass, and, therefore, can raise printing speed. Furthermore, the ink is water solubility substantially, therefore environment-friendly. Moreover, a heater 40 is a low power heater and, therefore, can be trusted. It is possible to reduce the risk of the Kogation (Kogation) of a heater by this. Furthermore, the printer of this invention operates with low power.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing one ink regurgitation nozzle of the ink regurgitation nozzle array of the print head currently irradiated.

[Drawing 2] It is drawing showing the liquid ink drop meniscus which the ink regurgitation nozzle of drawing 1 elongated.

[Drawing 3] A nozzle is drawing which was installed in the rotation cull cellular structure and in which showing an example of the equipment of this invention.

[Drawing 4] It is drawing showing the graph of the surface tension to time amount which compares ink with photosensitive ink conventionally which is nonphotosensitivity.

[Drawing 5] It is drawing showing the difference in expanding between the drops which irradiated with the drop of irradiated drawing 1 and were heated further.

[Drawing 6] It is drawing which was emitted by injecting according to an operation of light and heat and in which showing the drop of drawing 1 R> 1.

[Drawing 7] It is drawing showing the corner of the first arranged as a part of rotation rectangle cull cel of drawing 2 , and the second print head.

[Drawing 8] It is drawing showing the corner of the first arranged as a part of rotation rectangle cull cel of drawing 7 , and the second print head.

[Drawing 9] It is drawing which is used in order to help that a nozzle is installed in rotation cull cel arrangement, and the plate which carried out the electric charge makes a selection drop breathe out toward a receiver and in which showing an example of the equipment of this invention.

[Drawing 10] It is drawing which is used in order that a nozzle may be installed in rotation cull cel arrangement and the plate which carried out the electric charge may help expanding the selection drop which carries out contact migration of the selection drop to a receiver and in which showing another example of the equipment of this invention.

[Drawing 11] It is the sectional view of one ink regurgitation nozzle of the ink regurgitation nozzle array of a print head with the annular luminescence diode which surrounds a nozzle delivery.

[Drawing 12] It is drawing showing the liquid ink drop meniscus (false) which the ink regurgitation nozzle of drawing 11 elongated, and the breathed-out liquid ink drop which flies toward a receiver.

[Drawing 13] It is the sectional view of one ink regurgitation nozzle of the ink regurgitation nozzle array of the print head which has annular luminescence diode and the annular heater which surrounds a nozzle delivery.

[Drawing 14] It is drawing showing the liquid ink drop meniscus (false) which the ink regurgitation nozzle of drawing 13 elongated, and the regurgitation liquid ink drop which flies toward a receiver.

[Drawing 15] It is drawing showing the liquid ink drop meniscus in contact with a receiver which the ink regurgitation nozzle of drawing 11 elongated.

[Description of Notations]

10 Print Head
20 Ink Regurgitation Nozzle
30 Path
40 Annular Resistance Heater
45 Ink Object
50 Nozzle Delivery
60 Non-Elongated Drop Meniscus
65 Throat
70 Light Beam
75 Light Source
77 Light Beam
80 Elongated Meniscus
85 Cull Cel
90 Receiver, Medium
95 Arrow Head
97 Spindle
98 Meniscus
100 Electric Charge Platen
110 Connector
115 Piezoelectric Transducer
130 Ink Path

140 Ink Path
150 Drop
240 Luminescent Diode
500 Unit
501 Conduit

[Translation done.]